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SUSTAINABILITY IN HEALTHCARE ARCHITECTURE: The Case of Maggie Centres and their Effect on the Health and Wellbeing of Occupants.

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Abstract: The era of industrialisation and urbanisation has promoted the decline of healthcare architecture such that hospitals of today are no longer sustainable or advantageous to the health and wellbeing of users. This paper aims to analyse this by studying two Maggie Centres located in Oxford and Lanarkshire. These have been chosen because of their strong sustainability and humanity initiatives. Analysis of their light, views and thermal comfort aspects has been conducted in dynamic simulation software (IES-VE), with respect to the WELL Standard. Results show that they perform poorly with regards to daylight and thermal performance thus indicating that their design does not offer a positive contribution to the health and wellbeing of occupants. However, their biophilic qualities are regarded useful. It is therefore recommended that design of hospitals and care centres should include both qualitative and quantitative assessment of sustainability objectives lest they risk danger to the health of their visitors.
Keywords: Maggie Centre, Daylight, Biophilia, Sustainability, Healthcare.

1. Introduction

Health, according to the World Health Organisation (WHO), is not only the absence of disease, but also a condition of complete mental, social and physical well-being (WHO, 2021). It is also said to be an indication of one's way of life and by extension the evolution of healthcare architecture. Well-being, on the other hand, is defined as a positive individual or societal experience (ibid). Throughout history, humans have sought and created places where they can tend to, examine and recover from illness. These have ranged from small private areas to large hospitals that have since been redistributed to include fitness and community centres. Such changes in healthcare architecture are largely attributed to the era of industrialisation and urbanisation which saw regional hospitals being substituted for curtainwall or steel skyscrapers as a solution to high densities in the urban world (Verderber, 2010). Additionally, new treatment technologies have been developed in the form of large-scale diagnostic machines - such that the spatial design of most hospitals has shifted from prioritising human health to accommodating artificial systems, that increase not only the energy consumption of buildings, but also the emissions of harmful gases to the atmosphere. Consequently, they have failed greatly in "... meeting the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987).

Following this realisation, it has been suggested that healthcare design returns to or borrows elements from the Nightingale period which is said to be the peak for sustainability in this regard. This is because its strategies strongly advocated for healthier environments for the sick through an emphasis on good sanitation, fresh air, sunlight and nature in the design of healing places (Lynn, 2020). One such example of this style in the present day is evident in the story, brief and architecture of Maggie Centres that were founded by the late Maggie and her husband Charles, on a mission to create healthy environments for people suffering from cancer. They aim to raise the spirit of visitors without alienating them from their disease such that while they may question their fate, they learn not to be consumed by it (Jencks, 2015). The result is a collection of over 28 unique informal centres, scattered around the UK and internationally, where visitors can rely on their environment to provide emotional, practical and social support (ibid). This is by part due to the exceptional architectural brief which specifies neither area nor technical details, but instead forms a descriptive guide to warm hearty kitchens, cosy libraries, welcoming facades and beautiful landscapes- a domestic ethos (Page, 2015).

Furthermore, the design of each Maggie centre emphasises three themes – light, views and comfort which are said to be key elements of their sustainability and health initiatives. They will each be studied in this paper, with an aim of showing how healthcare architecture can be more sustainable and attune to the health and wellbeing of its visitors and occupants. This will be done through a comparative analysis of two Maggie centres in Oxford and Lanarkshire. They will both be modelled and studied in dynamic simulation software (IES-VE), with close reference to the WELL standard. It should also be noted that a few studies have been conducted in relation to this, but they are backed by only qualitative research so this paper also aims at bridging this gap and introducing a new approach to the study of healthcare architecture.

2. Methodology

2.1. Context of Maggie's Centres

The Maggie Centres in Oxford and Lanarkshire have been chosen because of the difference in their location, form and materiality despite experiencing the same temperate type of climate. For instance, Maggie's Oxford opts for a tripartite plan as a means of preserving existing trees and allowing visual permeability into the building as shown in **Error! Reference source not found.** below (ArchDaily, 2014). On the other hand, the design in Lanarkshire, as shown in **Error! Reference source not found.**, leans on the concept of a 'walled enclosure' such that the project seems like a private island with a perforated view onto the public scape (ArchDaily, 2015).

Figure 1 Maggies Oxford (ArchDaily,2014)

Figure 2 Maggies Lanarkshire (ArchDaily, 2015)

2.3. Daylight

Daylight is referred to as the light received from the sun and the sky in either diffuse or direct form. Proper daylight distribution is necessary to maintain good circadian and psychological health throughout the year (Well, 2014). Three main factors were studied in relation to this;

solar glare control, daylight fenestration and daylight modelling as highlighted in the Well Standard.

2.1.1 Daylight Fenestration

For good cardiovascular, endocrine, immune, muscular, nervous, digestive and reproductive systems, the Well standard recommends that the human body is exposed to natural light (WELL, 2014). To meet this criterion, building designs should allow for a window-to-wall area ratio between 20% and 60% (ibid). Both Maggie's have fully glazed façades adjacent to core spaces namely, group sitting zones, offices, kitchens and consultation rooms. This implies that the window to wall area ratio is 100% in both cases thus an advantage on the occupants' bodily systems. However, such a large ratio can cause glare and prove insignificant to occupants, especially when there is no shading device applied or if it is ineffective. As a result, occupants may be forced to close blinds and switch on artificial lighting during the day to avoid visual discomfort. This will hinder their health and well-being.

2.1.2 Daylight Modelling

In order to reduce dependence on artificial lighting, thresholds for indoor sunlight exposure need to be set in daylight modelling. This can be achieved by maintaining a balance between the spatial daylight autonomy (SDA) and annual sun exposure (ASE) such that adequate sunlight is received while excessive sunlight is avoided respectively (Well,2014). Therefore, it is recommended that at least 300 lux is achieved for at least 50% of the operating hours and no more than 10% of the area receives greater than 1000 lux for 250 hours each year (ibid). Table 1 shows the results following daylight simulation of core zones in both Maggie centres.

Table 1 Results showing percentage of annual sun exposure received in core zones.

	Group sitting zone	Kitchen and Dining	Office	Consultation rooms
Annual Sun Exposure (ASE) %age of area above 1000 lux for 250 hours	Maggies Oxford			
	66.67	0	100	24.14
	Maggies Lanarkshire			
	13.59	39.05	29.17	0
Spatial Daylight Autonomy (SDA) %age of area above 300 lux for 50% of hours	Maggies Oxford			
	100	100	100	100
	Maggies Lanarkshire			
	100	100	100	100

All rooms perform well in terms of SDA - that is, for most of the operating hours of the year, 55% of the spaces receive at least 300 lux of daylight. Nevertheless, the ASE in both cases exceeds the 10% criteria set by the Well standard, indicating that there is an excessive amount of direct sunlight being received. This could be attributed to the shape of the respective rooms and the proportion of glazing surfaces that border them. For example, the office in Maggie's Oxford has a small floor area in comparison to its large Southern glazed façade thus resulting in 100% of the area receiving above 1000 lux for 250 hours in a year. The same applies to the office in the Lanarkshire branch which although situated in the Northwest, receives too much sunlight. Consequently, the results indicate that the window to wall area ratio should be reduced in order to maintain a balance between the ASE and SDA. This will benefit the occupants more in terms of health and well-being and provide a sustainable solution to the designs. It should be noted, however, that the Lanarkshire centre performs much better than its counterpart in terms of annual sun exposure. This could be because it uses courtyards in its design which allow for light to be diffused rather than directed into the indoor spaces thus a lower amount of lux received.

2.1.3 Solar Glare

According to WELL (2014), occupants should be protected from direct sunlight through some form of glare control. This can be achieved by use of external or interior shading devices if the glazing is greater than 2.1m above the floor (ibid). Both Maggie's Oxford and Lanarkshire have horizontal overhangs and vertical projections respectively. This means that they adhere to the Well standard and are therefore deemed to positively contribute to muscle, nervous and skeletal health (Well, 2014).

However, the depth of these devices and their effectiveness is questionable. Szokolay (2008) recommends that shading is designed with respect to the solar azimuth, altitude and window dimensions. This ensures appropriate solar control during both overheated and underheated periods (ibid). Further analysis is conducted in this regard thus confirming that the vertical shading device on the Northeast façade of the Lanarkshire building is 0.7m short of the required 3.7m length. Similarly, the horizontal overhang on the Southern façade of Maggie's Oxford is too narrow to prevent glare from the sun. It is also designed in such a discontinuous manner that its depth varies depending on the space it shades. For example, the overhang in the office ranges between 0.5m and 1m, when it should measure 2.6m. Additionally, the overhang in the group sitting area ranges between 0.5m and 1m, yet it should equal to a 2m depth. This further explains the rooms' poor performance in terms of annual sun exposure as seen previously. Consequently, both Maggie Centres apply devices that are indeed too insufficient to protect occupants from visual discomfort.

3. Thermal Comfort

According to Race (2006), thermal comfort is defined as the absence of discomfort or wherever there is broad satisfaction with the thermal environment. It is crucial for the body's immune, integumentary, nervous and respiratory system that its temperature ranges between 36-38^{o}C (Well, 2014). For an environment to contribute to maintaining this limit, all occupiable spaces in naturally ventilated projects should adhere to the criteria set in ASHRAE Standard 55-2013, adaptive comfort model (ibid). The method demands that the building operative temperature lie within 80% of the acceptable limits when plotted against the mean outdoor air temperature (ASHRAE, 2013). Simulations were run in IES to analyse the performance of the Maggie centres in this regard.

Assumptions used follow the ASHRAE standard such that the occupants' metabolic rates range between 1.0-1.3 met, occupant clothing level between 0.5-1.0 clo and there is no mechanical cooling system applied. Furthermore, it is supposed that both buildings have 25 occupants during the opening hours- that is, each Monday through Friday between 9:00am and 17:00. The Oxford branch was modelled with a structural timber roof as well as a cross laminated timber structure for both wall and floor; all supported by glulam beams that raise the building off the ground, as in reality (ArchDaily, 2014). The structure of the Lanarkshire branch is also maintained as an external brick wall with steel frame structure infilled with timber (ArchDaily, 2015).

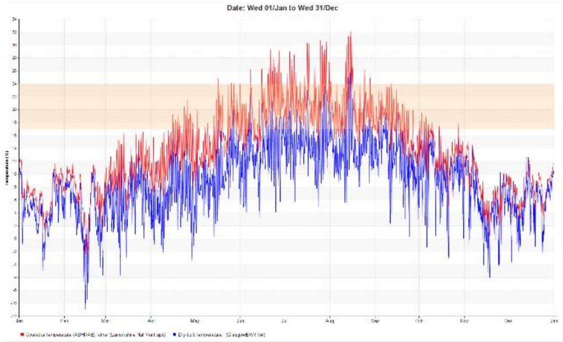

Figure 3 Thermal Comfort Lanarkshire

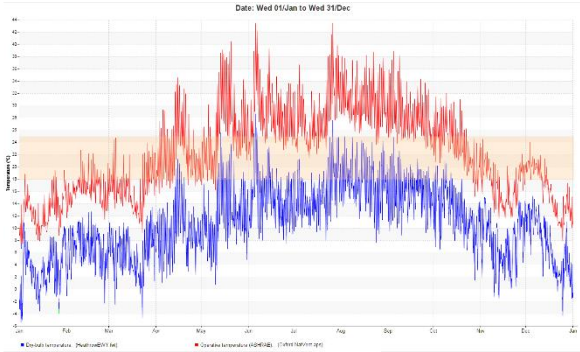

Figure 4 Thermal Comfort Oxford

Evidently, both Maggie centres perform poorly with regards to thermal comfort. This could be due to several reasons such as heat being lost through ventilation, glazing or the thermal envelope. The building in Lanarkshire for instance uses a high thermal mass which is known to slow the process of warming and increase the heating demand (CIBSE,2017). Using a lightweight construction such as timber could have therefore resulted in better thermal comfort results. The construction of the Maggie centre in Lanarkshire, nevertheless, allows it to perform better than its counterpart in Oxford, despite having a similar inconsistent and undulating trend. The former lies within 80% of acceptable limits (17^{o}C -24^{o}C) for a long period of time between mid-May and mid-September. The Oxford structure, on the other hand, falls within the comfort zone (18^{o}C -25^{o}C) for a shorter period during the months of April and October. This could be attributed to the fact that it has a poor thermal envelope coupled with fully glazed facades and ineffective overhang depths, resulting in high solar and heat gains. Consequently, it is recommended that the design reduces exposure to direct sun and, enhances night-time cooling as some of the ways to reduce overheating (CIBSE, 2017).

4. Biophilia

Biophilia is described as the inherent need for humans to be connected and affiliated with the natural world. Exposure to biophilia through greenery is said to improve one's general mood, experience and happiness. (Well, 2014) It is also generally good for the nervous system as exposure to images and vies of nature helps to speed up recovery and healing time, reduce negative feelings and boost positive ones (ibid) Analysis of this aspect is broken down into two sections namely, qualitative and quantitative.

The former requires that a biophilia plan is produced to show how nature is incorporated in the project, its patterns throughout the design and the sufficiency of opportunities for human interactions with nature (Well, 2014). As shown in **Error! Reference source not found.** and **Error! Reference source not found.**, both centres apply this feature excellently. Maggie's Lanarkshire incorporates the use of courtyards within the plan such that natural elements are viewed from the inner most private zones and the public areas of the project. The Oxford design also emphasizes biophilia through its 'treehouse' conceptual design that makes the centre look immersed in a forest. To attain the point for quantitative biophilic design, both projects need to first ensure that at least 25% of the site area has landscaped grounds that are accessible to the occupants of the building and makes up a minimum of 70% plantings (Well, 2014). Clearly, both Maggie Centres comply with this criterion, especially because their architectural brief specifies a well curated and beautiful landscape design to cater for the patients psychological and emotional well-being (Maggie, 2014).

5. Limitations and Conclusion

There was insufficient data available on the architectural and construction details of Maggie Centres so assumptions made may not reflect the actual design. The analysis is not extensive of all the different features and subcategories presented in the WELL standard, so the results are not indicative of whether the projects qualify for certification. Climate analysis and IES simulation of Maggie’s Oxford uses weather files from London Heathrow as there was none available for the specific city. Similarly, analysis of Maggie’s Lanarkshire relies on weather files extracted from Glasgow.

The design of Maggie Centres considers the health and well-being of its users especially in the aspects of biophilia and light. In their brief, form and concepts, they set a good example for achieving sustainability in healthcare architecture. Through analysis and research, however, the centres are clearly not designed in a sustainable manner- much less one that is beneficial to the health and wellbeing of occupants. Maggie’s Oxford, for example, lacks proper implementation of daylight and thermal comfort aspects, resulting in high heat gains and cooling demands. The branch in Lanarkshire also employs poor construction techniques that do not suit the climate and location of the building thus leading to poor indoor comfort results. Such effects can only lead to an increase in the use of energy, an unsustainable and unhealthy environment. In this manner, Maggie centres are indeed placebos (Borrett, 2013) or *‘beacons of hope’* (Martin, et al. 2022) and not healing places.

Moving forward, it is suggested that the design brief and process is inclusive of calculated decisions rather than only suggestive descriptions. This will ensure effectiveness of the building facades, form and materiality in terms of thermal performance, sustainability and health and well-being of occupants. Further investigation should also be carried out on the ventilation, heating and cooling strategies to show how the Maggie Centres, and healthcare architecture in general, can benefit from energy-efficient-led designs. The WELL standard proves to be a suitable guide in achieving a sustainable design that promotes health and well-being of building users too. It should nonetheless be used concurrently with existing standards such as Passivhaus, CIBSE and ASHRAE to achieve maximum results.

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